

## AXIAL FLOW TYPE COOLING FAN WITH SHROUDED BLADES

## FIELD OF THE INVENTION

5           The present invention relates to an axial flow type cooling fan with shrouded blades, characterized by: (1) having a driving unit which comprises electric coils on a casing and permanent magnets on a peripheral rim of a rotor assembly, (2) having the electric coils placed either on an upper casing or a lower casing or both upper and lower casings, (3) the rotor assembly having a central  
10   shaft, a plurality of blades and a peripheral ring, which form an integral body. By the arrangement of its structural parts, the present invention offers (1) an increased area of air flow and consequently increased air flow, no escaping of air from blade edges. (2) increased rotational stability at reduced noise, and (3) implementability of a flat shape, making the present invention suitable for notebook computers.

## DESCRIPTION OF RELATED ART

Microprocessors used in a computer are undergoing a fast development to ever greater performance, accompanied by an ever increasing demand on effective  
20   cooling. For better cooling, the following approaches have been taken:

- (1)   Change of material, like substituting copper, silver, gold.
- (2)   Increasing heat-radiating area.
- (3)   Reducing weight of fins.
- (4)   Increased air flow.
- 25   (5)   Reduced drag for higher air flow pressure.

Among these measures, (1), (2) and (3) are improvements on heat sinks, while (4) and (5) improve ventilators. However, due to limitations of structure, always having a motor with a shaft, increasing air flow and reducing drag is fraught with difficulties.

A conventional cooling fan has a rotor, mounted on a rotationally symmetric stator which carries an electric coil. Sending a varying electric current through the coil causes a varying magnetic field between the stator and a rotor, which consequently rotates, controlled by regulating the electric current through the coil. The rotor is mounted using a sleeve bearing, a ball bearing or a magnetic bearing. Direct driving of the shaft of the rotor results in the following problems: (1) Air flow is achieved only in a narrow area. (2) Supports of the driving unit in the air flow result in vortex shedding and noise. (3) Large quantities of air escape from edges of ventilator blades.

A cooling fan, disclosed in Taiwan patent no. 528178, comprises, as shown in Fig. 3, an upper casing 1, forming a stator, a lower plate 2, and a set of blades 3, mounted inside the stator. The upper casing 1 has a central hole, from which a circular upper rim extends downward. Similarly, the lower plate 2 has a central hole, from which a circular lower rim extends upward. The lower rim has an outer diameter that is smaller than the inner diameter of the upper rim and carries on an outer periphery at least two permanent magnets 4. Coils 5 are wound on the upper casing 1. The set of blades 3 has an outer diameter that is smaller than the inner diameter of the lower rim and has a shaft 3a and a plurality of blades 3b. This design of a cooling fan is disadvantageous for a flatter shape.

## SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an axial flow type cooling fan with an increased area of air flow, resulting in increased air flow, better rotational stability and allowing for a flatter shape, so that a more compact shape, lower noise, longer lifetime and more versatility for use in small devices like pen computers are achieved. The present invention comprises: an upper casing and a lower casing, enclosing an inner space; a rotor assembly in the inner space, having a central shaft, a plurality of blades and a peripheral ring, which together form an integral body; and a driving unit, driving a rotational movement of the rotor

assembly. The driving unit further comprises electric coils on the upper or lower casings and permanent magnets on a peripheral rim of the rotor assembly. By this arrangement, increased air flow at better rotational stability and reduced drag is achieved.

5           Another object of the present invention is to provide an axial flow type cooling fan with better rotational stability.

          A further object of the present invention is to provide an axial flow type cooling fan which prevents air from escaping from far edges of blades.

10           A further object of the present invention is to provide an axial flow type cooling fan which allows for a flat design.

          The present invention can be more fully understood by reference to the following description and accompanying drawings.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

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          As shown in Figs. 1 and 2, the axial flow type cooling fan of the present invention comprises: an upper casing 10; a lower casing 20; a rotor assembly 30; and a driving unit 40, driving a rotational movement of the rotor assembly 30.

20           The upper and lower casings 10, 20 are fastened to each other by bolts or hooks, forming a complete enclosure for the rotor assembly 30 and the driving unit 40.

25           The rotor assembly 30 has a central shaft 32, carrying a plurality of blades 33. The blades 33 have outer edges that carry a peripheral ring 34. A peripheral rim 35 extends from the peripheral ring 34 outward. Permanent magnets 31 are attached to the peripheral rim 35.

          The driving unit 40 drives the rotating movement of the rotor assembly 30 with respect to the upper and lower casings 10, 20. The driving unit 40 has coils 41, which are placed facing the permanent magnets 31 of the rotor assembly 30.

30           When an electric current passes through the coils 41 of the driving unit 40, a magnetic field between the coils 41 and the permanent magnets 31 on the

peripheral rim 35 of the rotor assembly 30 results. By regulating the electric current through the coils 41, the rotating movement of the rotor assembly 30 is controlled.

According to operative needs, the coils 41 are either placed on the upper casing 10 or the lower casing 20 or both the upper casing 10 and the lower casing 20.

For stability of the rotational movement, a seat 21 on the upper casing 10 and the lower casing 20 supports and guides the rotor assembly 30 during the rotational movement thereof.

The main characteristics of the present invention are as follows:

- (1) The driving unit 40 consists of the coils 41 on the upper casing 10 and the permanent magnets 31 on the peripheral rim 35 of the rotor assembly 30.
- (2) The permanent magnets 31 are inserted in the peripheral rim 35 of the rotor assembly 30.
- (3) The shaft 32, the blades 33 and the peripheral ring 34 of the rotor assembly 30 form an integral body.

By the setup described above, the present invention has the following capabilities:

- (1) The area of air flow is enlarged, increasing air flow and reducing drag.
- (2) Driving the rotor assembly 30 by the driving unit 40 provides for a more efficient rotational movement, with increased stability and less noise.
- (3) By integrating the blades 33 and the peripheral ring 34 of the rotor assembly 30 into a single body, no air leaks away from the edges of the blades 33.
- (4) The driving unit 40 allows for a flat shape of the cooling fan.

While the invention has been described with reference to a preferred embodiment thereof, it is to be understood that modifications or variations may be easily made without departing from the spirit of this invention which is defined by the appended claims.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a top view of the axial flow type cooling fan of the present invention.

Fig. 2 is a cross-sectional view of the axial flow type cooling fan of the present invention, taken along line 2 - 2 of Fig. 1.

5 Fig. 3 is a cross-sectional view of a conventional axial flow type cooling fan.